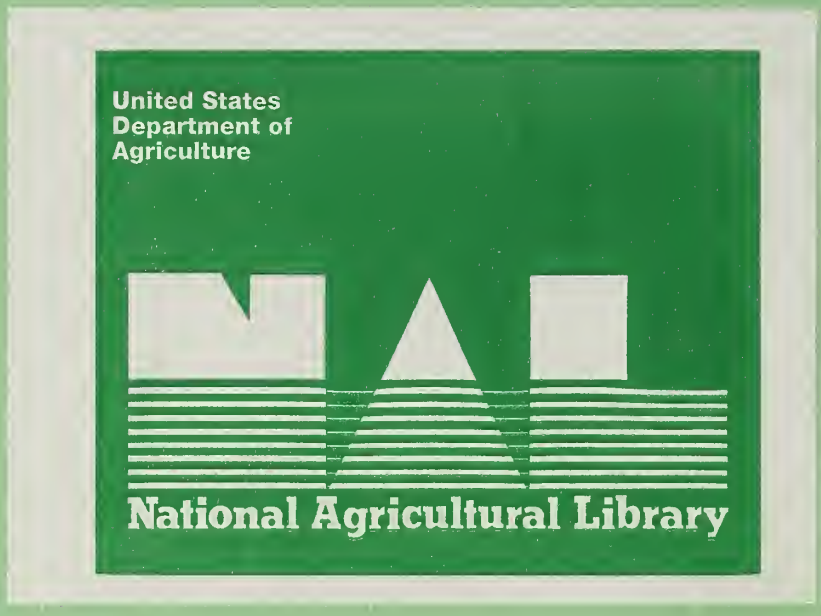
WATERSHED WORK PLAN
CHERRYSTONE WATERSHED

Pittsylvania County, Virginia

Prepared Under the Authority of the
Watershed Protection and Flood Prevention
Act (Public Law 566, 83d Congress, 68
Stat. 666) as amended.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Prepared Under the Authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress, 68 Stat. 666), as amended.

Prepared by: Pittsylvania Soil and Water Conservation District

Pittsylvania County Board of Supervisors

Town of Chatham, Virginia

With assistance by:

U. S. Department of Agriculture, Soil Conservation Service

U. S. Department of Agriculture, Forest Service
in cooperation with the Virginia Division of Forestry

Virginia Soil and Water Conservation Commission

February 1965

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SUMMARY OF PLAN

This watershed work plan for Cherrystone watershed, Pittsylvania County, Virginia, was prepared by the Pittsylvania Soil and Water Conservation District, the Pittsylvania County Board of Supervisors and the Town of Chatham, the sponsoring local organizations. Technical assistance was provided by the Soil Conservation Service, the Forest Service of the U. S. Department of Agriculture, cooperating with the Virginia Division of Forestry, of the Department of Conservation and Economic Development, and the Virginia Soil and Water Conservation Commission. Other state and federal agencies assisting were the Agricultural Stabilization and Conservation Service, the Virginia Department of Highways, the Virginia Agricultural Extension Service, and the Fish and Wildlife Service of the U. S. Department of Interior.

The Cherrystone watershed as set forth in this plan drains 29,400 acres in Pittsylvania County, Virginia. The downstream boundary of this watershed is the confluence of Cherrystone Creek and the Banister River.

This is primarily an agricultural watershed with a history of frequent, damaging floods. This frequent flooding damages business property, crops and pasture, fences, farm roads and bridges, public highways, railroads and other improvements in the flood plain. Also a portion of the Town of Chatham, county seat of Pittsylvania County, is located in the flood plain near the center of the watershed. The use, management and development of some of the most productive and valuable land in the watershed is severely limited by these floods. There is also a problem with erosion of the uplands and scouring, deposition and swamping on the bottomlands. The water supply for the Town of Chatham is inadequate for the planned expansion. The area benefited includes 729 acres of bottomlands. Without the project 597 acres are flooded by the five-year frequency storm. With the project installed, the five-year frequency storm will flood only 21 acres of agricultural land; with three-year frequency protection to the entire flood plain. The project will also provide 100-year frequency protection to 80 acres of land in and adjacent to the Town of Chatham which is zoned for industry and business. Also, 850 acre-feet of municipal water storage for the Town of Chatham will be included in one of the impounding structures. Average annual direct damages

will be reduced almost 98 percent by the acceleration of land treatment measures, one multiple-purpose structure, two floodwater retarding structures and 5.55 miles of stream channel improvements.

It is anticipated that the project will be completed in five years at a total installation cost of $870,244, with Public Law 566 funds bearing $581,145 and others bearing $289,099 of the cost. Land treatment measures are estimated to cost $291,275, with Public Law 566 funds bearing $70,942 for accelerated technical assistance and materials for critical area treatment and others bearing $220,333 of the installation cost. In addition, the local landowners have already installed land treatment measures amounting to $329,296. The structural measures are estimated to cost $578,969 with Public Law 566 bearing $510,203 and others $68,766.

The Town of Chatham will be responsible for the operation and maintenance of the multiple-purpose structure (Dam No. 1) at an estimated cost of $700 annually. The Pittsylvania Soil and Water Conservation District will be responsible for the operation and maintenance of all other works of improvement (estimated cost $1864 annually). This responsibility will be implemented by maintenance agreements with the landowners in the watershed. Also, the Virginia Soil and Water Conservation Commission of the Commonwealth of Virginia will assist the District within the policy of an existing resolution.

The Town of Chatham will secure the easements and rights-of-way for the construction of Dam No. 1. The Pittsylvania Soil and Water Conservation District will have the responsibility for obtaining easements and rights-of-way for all other structural measures and the successful application of the plan.

The average annual cost of structural measures is estimated to be $21,531 and the average annual benefits are estimated to be $30,868, giving a benefit-cost ratio of 1.4 to 1.0.

DESCRIPTION OF THE WATERSHED

Physical Data

General - The Cherrystone watershed has a drainage area of 29,400 acres, all of which is in Pittsylvania County, Virginia. This watershed is somewhat of a warped oblong shape, being about 11.5 miles long and varies in width from 3.5 to 4.5 miles. It is a tributary of the Banister River in the Roanoke River Basin. The stream gradient in Cherrystone Creek averages about 10 feet per mile. Six tributaries make up the major portion of the drainage area in this watershed. Pole Ridge Branch enters Cherrystone Creek about three-fourths of a mile upstream from Dam No. 1.

Roaring Fork flows into the main stream about one-half mile downstream from Dam No. 1. Green Rock Branch enters the main stream about a mile downstream from Chatham; with the confluence of Tanyard Branch about two miles further downstream. Little Cherrystone Creek enters the main stem about one-half mile upstream from the confluence with the Banister River. Other smaller tributaries flow into the main stem at irregular intervals along its course. Stream flow is usually good, however discharges during dry seasons are often low for the amount of drainage area in the watershed.

The watershed is in the southern Piedmont Plateau section of Virginia and is characterized by gently rolling to somewhat hilly land. The elevations in the watershed range from 965 feet above mean sea level along the ridges of the watershed boundary to 550 feet at the confluence of Cherrystone Creek and the Banister River.

The economy of the area is largely dependent upon agriculture and related industries. In 1959 the county ranked first in Virginia in the value of sales from crops and second in the value of sales from all farm products. However, there are considerable opportunities for off-farm employment in Chatham and nearby Danville.

There are approximately 17,811 acres of forest land. These lands are well suited to the production of timber products and under protection and management improvement of the forest hydrologic condition is expected.

Geology - The area drained by the Cherrystone watershed is underlain by sedimentary and metamorphic rocks. The metamorphic rocks are listed 1/ as "metamorphosed sediments of uncertain age," the formation is the Wissahickon, and age is probably Pre-Cambrian or early Paleozoic. The sedimentary rocks are of Triassic age and belong to the Newark Group. This particular area is in a division called "the Danville Basin." Scattered throughout the area is an occasional Triassic basic dike of diabase. Locally these dikes would be very important but for the watershed as a whole these dikes are insignificant.

The Wissahickon formation is composed of gneiss and schists containing quartz, feldspars, chlorite, muscovite biotite, garnet and minor accessory minerals.

The Triassic Newark Group is composed of shale, sandy shale, siltstone, sandstone, arkosic sandstone, conglomerate, and in a few places thin beds of coal.

1/ Geology and Ground-Water Resources of Pittsylvania and Halifax Counties, Legrand, H. E. VDMR, Bul. 75, 1960

Soils - Most of the soils of the watershed were formed from acid schist or gneiss parent material. These formations contain considerable amounts of mica, and in places have a few intrusions of basic rock.

The Congaree, Chewacla, Wehadkee soil association make up a major portion of the flood plain of this watershed. Small areas of Wickham, Altavista and mixed alluvial soils are found on terraces along the small streams. These soils have been developed from old stream-deposited material that was washed from the uplands. This group of soils occupies gentle slopes (0 to 2 percent) and runoff is slight.

The Chewacla and Wehadkee series occupy most of the flood plain area, with smaller amounts of Congaree and mixed alluvial deposits. These soils are highly productive, but are subject to frequent flooding. If protected from overflow, they are well suited for the production of corn, small grain, truck crops, grasses and clovers. These soils are classified as Class IIw and IIIw depending on the susceptibility to flooding and permeability.

The chief upland soils are of the Cecil, Madison and Louisa series. These soils were developed from weathered products of quartz, mica, gneiss, granites and to a lesser extent quartz, mica, schist and greenstone. They are moderately deep to deep, medium textured, permeable, acid soils occupying slopes ranging from 3 to 25 percent. In some places these soils contain cobbles and gravel. Runoff is moderate.

There are small areas of Appling, Durham, Louisburg, Colfax, Lloyd, Enon, Wilkes and Mecklenburg soils scattered throughout the watershed. Of these soils, the Appling, Durham, Louisburg and Colfax are developed from acid materials. The Colfax soils occur on 0 to 3 percent slopes; the Appling and Durham on 2 to 15 percent slopes, while the Louisburg soils occupy the higher slopes of up to 45 percent. The Lloyd, Enon, Mecklenburg and Wilkes soils are of mixed acid and basic parent materials. The Enon and Mecklenburg soils are found on slopes of 2 to 10 percent, with the Lloyd and Wilkes occupying slopes of up to 40 percent. Appling, Durham and Lloyd soils are deep with moderate to rapid runoff, the latter occurring on the Lloyd. The Enon, Mecklenburg and Colfax soils are moderately deep with moderate runoff, while the Louisburg and Wilkes are shallow, excessively drained soils.

Climate - Temperatures in the Cherrystone watershed average about 40° F. in the winter and 78° to 80° in the summer. There are occasional hot days in summer when the temperature may reach the middle or upper 90's. Quite often in the winter cold spells with nighttime temperatures below freezing will last up to a week, but seldom does the temperature get below zero. The maximum and minimum recorded temperature extremes are 105° and -3°

Fahrenheit. Average annual rainfall is about 42 inches. Most of this precipitation falls as rain, with snow storms being rather infrequent. A large number of the storms which cause flooding occur during the growing season. However, floods have been recorded in all months.

The average frost-free growing season is about 190 days from mid-April to late October or early November. This season is ample for such crops as tobacco, corn, small grain and crops grown in support of livestock and poultry enterprises. Frequently people harvest two crops of vegetables from their gardens.

Land Use and Cover Conditions - This area is and in the past has been primarily in agricultural use. Early agricultural and logging practices caused very serious erosion problems. Recent improvements in the techniques of farming and conservation measures have lessened this problem considerably. Cover conditions now are generally good due to the recent emphasis on livestock, a reduction in cultivated crops and improved woodland management. However, there are a few small areas in the watershed which are in need of special attention for conservation measures. Approximately 25 percent of the farms in the watershed are being operated according to soil and water conservation agreements with the Pittsylvania Soil and Water Conservation District. A continuing effort is being made to develop more widespread use of soil and water conservation plans by the landowners. The present open land classification of cover is 59 percent good, 35 percent fair, and 6 percent poor to very poor. Present land use in the watershed is 5,069 acres cultivated; 2,359 acres in pasture; 17,811 acres of forest land and 4,161 acres in miscellaneous uses and idle.

Economic Data

It is estimated that there are approximately 4,600 people living in the Cherrystone watershed; about 2,000 of whom live in Chatham. Of the residents of the watershed who live outside of the Town of Chatham, about 1,800 live on small tracts and part-time farms, securing all or part of their cash income from off-farm employment. The trend to this type of development has been consistently increasing in recent years as the industrial development of the area has progressed and the highway and communications systems improved. However, most of the area is expected to remain predominently in agriculture.

Presently there are 206 farming operations in the watershed. The average size farm is 108 acres. These farms vary in size from less than fifty acres to 426 acres for the largest operation. Some of these are one family, owner-operator units, some are owner-operated with hired labor and others are operated on a

share-of-profits basis. An estimated 40 landowners own flood plain land in tracts ranging from an urban lot to about 50 acres. Except for a small acreage owned by the Town of Chatham for public utilities the entire watershed is private ownership.

There are 729 acres of flood plain which are subject to damage by the 100-year frequency storm. Of this area only about 10 percent is presently devoted to cultivated crops, approximately 47 percent is in pasture, over 41 percent is idle and woodland, with slightly more than one percent in miscellaneous uses in and adjacent to Chatham.

These flood plain lands are estimated to range in value from less than $25 per acre in some of the areas to about $150 per acre for some of the wider, more assessible agricultural areas downstream from U. S. Highway 29. The local committee estimates that this land will increase in value to from $400 to $2,500 per acre with the project installed; depending upon the use and level of protection.

In 1959,Pittsylvania County was first in Virginia in value of sales from crops and second in the value of sales from all farm products. More than three-fourths of the county's cash income is derived from tobacco. Other major crops include corn, wheat, barley, soybeans, vegetables, sweet potatoes and Irish potatoes. Cattle production, dairy and poultry enterprises, have made significant gains in recent years. The sale of livestock and livestock products increased from 6.6 percent of all farm income in 1954 to 15.6 percent in 1959. The dollar volume of sales from livestock and livestock products increased almost 152 percent during this period, while the dollar increase from the sale of crops was only about 6.5 percent.

Forests covering 17,811 acres consist of the following: hardwood stands 24 percent; mixed hardwood and softwood stands 42 percent; and softwood stands 34 percent. Principal hardwood species consist of white, chestnut, northern red, southern red, black, scarlet, and willow oak along with hickory, yellow poplar, black and sweet gum, red maple, river birch and sourwood. Softwood stands consist of Virginia, shortleaf and pitch pine in natural stands and scattered loblolly pine plantations.

Approximately 65 percent of the forest land supports stands of sawtimber size having more than 1,500 board feet per acre; 23 percent has pole size timber and 12 percent has seedlings and saplings.

There is a good demand for all types of forest products at nearby concentration yards and sawmills. All of the timber area is readily accessible by a network of state and county roads.

All of the forest land on this watershed is in small farm holdings.

Forest fire protection is provided by the Virginia Division of Forestry through the Clarke-McNary Cooperative Forest Fire Control Program, assisted by local volunteer fire companies. Other going Federal-State cooperative forestry programs include Cooperative Forestation (C-M4), and Cooperative Forest Insect and Disease Control.

Given protection, care and management, these forest stands are expected to contribute to the future overall economy of the watershed.

Eighty acres in and adjacent to the Town of Chatham which is zoned for industrial use is currently idle or in brush woodland. Development in this area has been retarded because of the flood problem.

Major sources of off-farm employment in the watershed and nearby area are in processing and marketing of agricultural products, manufacture of textiles, sheets and pillow cases, knitwear, hosiery, apparel, printing, lithographing, ready mixed concrete, cement, building blocks, vaults, elevators, machine tools, paints, industrial machinery, pre-fabricated homes,mattresses, springs, paving blocks, power saws, paper tubes, business forms and scientific and industrial glass. Retail and wholesale business establishments both in the watershed and nearby also offer opportunities for employment. The largest single-unit textile mill in the world is located in Danville, eighteen miles south of Chatham on U. S. Highway 29. Danville is also the State's largest tobacco market and ranks among the largest in the nation and the world.

This watershed is served by U. S. Highway 29, Virginia route 57 and a network of all-weather secondary roads allowing access to all parts of the watershed. This system of roads provides ready access to all parts of the nation.

The main line of the Southern Railway, Washington-Atlanta Division, provides rail service to the watershed. Regularly scheduled daily freight and passenger service is available, and the numerous inter-connections of this railway give access to the railway network of the nation. Overnight passenger service is provided to New York, Atlanta and intermediate points. The Virginia Trailways system offers frequent daily schedules to Charlotte, North Carolina, Washington, D. C. and New York City with connections for all parts of the nation. Commercial large scale air transportation is available at the Danville Airport seventeen miles south of Chatham. This airport is served by Eastern Airlines and Piedmont Airlines. Both companies connect with airlines serving all parts of the world. Air charter service is also available at this airport. Motor freight facilities are provided by a number of common carrier motor lines from terminals in the watershed and nearby. These services are considered adequate for any anticipated needs of the area.

In addition to the Town of Chatham, the City of Danville and several nearby towns, the watershed is within 150 miles of the metropolitan centers of Richmond, Roanoke, and Norfolk, Virginia; Raleigh and Charlotte, North Carolina; Columbia, South Carolina and Washington, D. C. These areas provide easily accessible markets for both the agricultural and industrial production of this watershed.

Recreation

Chatham has a supervised recreation program carried on during the summer months with tennis, swimming and other outdoor sports to be enjoyed. They also have a baseball park lighted for night games.

Wildlife in the watershed is limited chiefly to rabbits, quail and squirrels, with an occasional turkey and deer. Cherrystone Creek and its tributaries provide very limited fishing for the local population. Development of outdoor recreation in the watershed has been rather limited to date. However, with continued industrial growth in the area, the development of recreational features is expected to expand rapidly. The incidental recreational facilities associated with this watershed work plan are expected to be utilized to a high degree.

WATERSHED PROBLEMS

Floodwater Damage

The Cherrystone watershed has a long history of frequent flooding, with severe damaging floods occurring at 5 to 10-year intervals. Seven hundred twenty-nine acres of flood plain land are susceptible to flooding from the 100-year frequency event.

A major portion of this flood plain area is, or with protection would be, devoted to agricultural use with the accompanying fixed improvements such as farmsteads, fences, farm roads, etc. There are a number of rural non-farm properties in the flood plain with a history of damage. The network of public highways in the flood plain is frequently blocked and damaged by floodwater causing excessive maintenance and prolonged traffic detours.

A portion of the Town of Chatham occupies most of Reach II and the lower third of Reach I. This area is zoned for industrial use. However, very little development has taken place because of the flood problem. Only two of the 88 acres in this area have been developed. The remainder is now idle or brushy woodland with little or no productive use being made of it. This area is immediately adjacent to the main line of the Southern Railway and about a mile established siding trackage. There is room for this siding to be lengthened approximately another half a mile if future industrial development should make it desirable and feasible.

One of the more recent severe storms occurred in August 1955, causing damage in excess of $30,000 to existing flood plain improvements, highways, crops and pasture. Another,but less severe storm, occurred in August 1964, causing between $10,000 and $20,000 in damages. A more severe storm in 1944, caused the loss of one life and damages approaching $100,000. This flood problem is seriously affecting the growth of Chatham and the adjacent area of Pittsylvania County and the value of the flood plain land. The value of the land in this area of the watershed varies from $50 per acre for the flood plain subject to relatively frequent overflow to $3,000 per acre for upland which is adjacent to the rail siding.

The population and industrial expansion in the area in recent years has provided an expanded market for dairy products, meat animals, poultry and eggs. This situation has influenced a gradual change from a tobacco, cash grain type of agriculture to a more diversified operation to include livestock or poultry. Modern technology makes possible the operation of some of the small family-type farms on a part-time basis, with a substantial portion of the family income obtained from off-farm employment in local industries and businesses. This type of operation is expected to contribute significantly to the economic stability of the community. It is anticipated that the larger farms will continue to place more emphasis on livestock operations with an increase in grass and hay land and a corresponding decrease in surplus crops such as tobacco and wheat.

Erosion and Sediment Damage

Erosion of the upland has been a very serious problem in the past. In recent years soil conservation practices have been applied which have partially alleviated the problem. The production of livestock has been accelerated, thereby increasing the grassland and reducing the cultivated cropland.

Sheet erosion on the uplands and road cuts and fills are the chief sources of sediment. This sediment is deposited on crop and pasture land and flood plain improvements during the frequent flooding of these areas.

Overbank deposition consists mainly of sand and silt from the eroding uplands in the watershed. The bottomland survey shows that about 165 acres of agricultural land have been damaged in amounts ranging from 10 to 20 percent. The average annual monetary damage is estimated at $933 at long-term price levels.

The bottomland survey shows that 14 acres of agricultural land have been damaged by flood plain scour in amounts ranging up to 40 percent. The average annual damages were estimated to be $164 at long-term price levels.

Problems Relating to Water Management

Consumption of water at Chatham has increased about 25 percent in the last 5 years. Their present supply is taken from the main stream of Cherrystone Creek at a small check dam across the channel about 2,000 feet upstream from Highway 57.

The consultant engineer retained by the town reports that in a prolonged drought the flow of the stream is considered critical for supplying present customers. The report further states that irrigation uses could reduce the flow to a point that would be insufficient for the present system. Also a serious problem of fire protection would exist during prolonged dry periods. This limited supply of good quality water is adversely affecting the existing businesses and industries as well as limiting the future growth and economic development of the area.

In order to service the planned urban and industrial expansion, the dependable supply of municipal water must be increased. On the strength of the consultant's report, the town is going to cooperate in the construction of a multiple-purpose dam which will provide 850 acre-feet of municipal water in addition to the storage required for floodwater.

PROJECTS OF OTHER AGENCIES

This plan as proposed is not in conflict with existing laws or regulations. There are no existing or proposed projects for water resource development which will affect the proposed works.

BASIS FOR PROJECT FORMULATION

A study of the watershed revealed that the area is chiefly in agricultural use. However, a portion of the flood plain lies in and adjacent to the Town of Chatham which is zoned and has potential for industrial development if protected from flooding.

It was decided to strive for at least 3-year frequency protection to the agricultural flood plain and a 100-year frequency protection to the area at Chatham which is zoned for industrial use. Storage of municipal water for the Town of Chatham was also a major consideration in the formulation of the project.

A continuing relative increase in livestock, dairy and poultry production is expected to increase the on-farm useof feed grains. This is also expected to increase the production of forage and hay crops, with a decrease in cash crops such as tobacco and wheat.

By providing additional potential for off-farm employment, it is expected that the income of operators of small family farms will be materially improved.

The guiding principle used in formulating the project was to accomplish the objectives of the sponsoring local organizations and produce maximum net benefits. Comparisons were made between alternate locations and types of construction.

Preliminary investigations indicated that one multiple-purpose structure for floodwater and municipal water storage, two single purpose floodwater detention structures and 5.55 miles of stream channel improvements would be the most logical project to meet the stated objectives. The structures were designed with a 100-year sediment capacity to provide for maximum useful life of the project.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

The accelerated program of operations for soil and water conservation will be a deciding factor in the complete success of this plan. Approximately 25 percent of the farms in the watershed have conservation plans established or in process of establishment at the present time. A diligent effort is being made to complete farm plans for all farms in the watershed. The installation of conservation practices will be accelerated to meet the goals of this plan.

The land treatment measures will improve the cover conditions in this watershed, leading to improved hydrologic conditions. With the improvement of cover conditions there will be a reduction in runoff, erosion and sediment production.

Open Land - A reduction of sediment now being deposited in the stream channels and on the flood plain will result from the installation of such practices as contour stripcropping, grassed waterways, diversions, row arrangements and the use of cover and green manure crops on the uplands. Also it is expected that there will be a net decrease of 428 acres of cultivated cropland. Most of this land is marginal in productive capacity and will probably be planted to trees.

The rate of infiltration will be increased by the installation of such practices as conservation cropping systems, contour farming, proper use of crop residues and plow planting. These will act as preventive measures for surface runoff for small storms.

The removal of excess runoff and seep water from uplands will be accomplished by the installation of tile and open ditch drainage at selected locations.

Construction of farm ponds in the watershed will be for livestock water, fire protection, irrigation and recreation. With livestock water more readily available, overgrazing and undergrazing will be reduced with the increase of rotational grazing systems. This will tend to increase vegetative cover and reduce soil erosion and sedimentation.

Pasture and hayland planting combined with wildlife habitat development and the use of grasses and legumes will provide a greatly improved hydrologic condition, increase infiltration and reduce runoff and erosion.

Critical area planting is limited mainly to roadside erosion control. It consists of grading, sloping, seeding, fertilizing, and mulching of roadbanks which will considerably reduce the sediment contribution of these areas.

Forest Land Measures - The following program has been developed by the local people from a statement of land treatment needs prepared by the Virginia Division of Forestry in cooperation with the U. S. Forest Service.

A. Tree Planting - Reforestation of appropriate open land is necessary to adjust land use with capability and to reduce runoff and erosion by developing a protective cover and an absorbent forest floor "sponge" of humus and litter.

B. Hydrological Cultural Operations - These cultural operations are aimed at improving hydrologic conditions by manipulation of stand composition to create favorable conditions for the maximum production and protection of litter, humus and forest cover. They include weedings, thinnings, improvement, release and harvest cuttings.

C. Woodland Grazing Control - The fencing out of domestic livestock prevents impairment of hydrologic conditions in woodlands by: reducing soil compaction and damage to tree roots, seedlings and other ground cover. Preventing this damage allows the litter and humus to build up to a desirable level.

D. Skid Trail and Logging Road Erosion Control - This measure will reduce runoff, erosion and sedimentation by diverting water from eroding skid trails and logging roads. Simple water bars (ditches with pole or earthen diversions)spaced at specified intervals are the usual means of controlling or diverting water.

Structural Measures

One multiple-purpose structure for floodwater and municipal water storage, two single purpose floodwater retarding structures and 5.55 miles of stream channel improvements are planned for this watershed project. The principal spillway will consist of a conduit of reinforced concrete with a two-stage drop inlet. The sediment storage capacity for the structures will be equivalent to the estimated sediment accumulation for a 100-year period and will total 807 acre-feet.

The total floodwater detention capacity will be 5,009 acre-feet, which is equivalent to an average of 3.85 inches of runoff from the total area above dams. The total area above the three dams is 15,593 acres, which comprises 53 percent of the entire watershed. Seventy-five percent of the area will be controlled above the area zoned for industrial development in Chatham. There will be 850 acre-feet of municipal water storage for the Town of Chatham in site number 1. This water will be released from the structure by headgates in the riser. The $4,500 estimated cost of these headgates and the catwalk needed to operate them will be borne by the town.

There will be 5.55 miles of stream channel improvements on the main stem of Cherrystone Creek beginning in the downstream portion of Reach I and extending to its confluence with the Banister River. A short dike will also be constructed near the upper end of Reach II to prevent the flood flows from an uncontrolled tributary from spreading over the main stem flood plain.

The total installation costs for structural works of improvement to be installed are estimated to be $578,969.

The combination of dams and channel improvements will provide a minimum 100-year frequency protection to the industrial area at Chatham and a three-year frequency level of protection to the agricultural flood plain in the watershed. For a more detailed breakdown of costs and design see Tables 2, 2A, 3A, and 3B.

EXPLANATION OF INSTALLATION COSTS

Land Treatment Measures

The installation costs for land treatment measures are shown in Table 1. The total installation cost for the Soil Conservation Service land treatment measures is $228,575. Of this total, P.L. 566 costs are $59,942 and the costs from other funds $168,633. The P.L. 566 funds represent the cost of technical assistance and materials for critical area treatment. The other funds represent the estimated cost of installing the land treatment measures.

The cost of technical assistance for the installation of land treatment measures was based on an analysis of actual Service expenditures and Soil and Water Conservation District accomplishments for the past several years.

Total cost of installing the forest land treatment measures is $62,700 of which $11,000 will be furnished from P. L. 566 funds and $51,700 will be provided from other funds.

Costs for the installation of forest land treatment measures are based on current costs of supervision, labor, equipment and materials needed for each measure. Costs of technical assistance are based on actual expenditures and accomplishments of the Virginia Division of Forestry. An analysis of costs against accomplishments was made for each measure to determine unit costs.

Structural Measures

Cost computations for structural measures were made at current prices based on calculated quantities and estimated unit costs for construction items obtained from bid prices for works of similar nature constructed in the State. Estimated contract costs, based on quantities, were increased 12 percent for contingencies to cover unforeseen difficulties and expenses that might occur later.

Engineering estimates (including the 12 percent contingency factor) constituted approximately 76 percent of the total installation cost. Installation services include engineering costs, inspection, additional geological investigations needed for final design of the works of improvement and administrative overhead costs. These costs accounted for approximately 20 percent of the estimated total installation costs. Easements, rights-of-way and relocation of facilities accounted for the remainder of the estimated costs involved in installing the works of improvement.

Rights-of-way cost estimates were obtained by an easement committee of the sponsors. The costs vary from $25 to $150 per acre for the pool area, borrow, structure and emergency spillway areas depending on location, present and anticipated use of the lands. The cost of channel improvement easements were also provided by the easement committee.

Total installation costs for structural measures are estimated to be $578,969. Of these costs $510,203 will be borne by P.L. 566 funds and the balance of $68,766 from other funds. Tables 1 and 2 summarize structural measure costs.

The use of facilities method of cost allocation as described in Chapter 10 of the Economics Guide and Section 1132.1 of the

Watershed Protection Handbook was the method used to allocate the cost of the multiple-purpose structure. The specific costs to be paid for entirely from local funds, for water supply storage includes the following items: headgates, catwalk, and trash racks for dam number 1.

The Town of Chatham will provide 18.39 percent of the joint installation costs of structure number 1 and P.L. 566 funds will provide 81.61 percent of the costs. All installation costs of structures 2 and 3 and stream channel improvements will be borne by P.L. 566 funds. Tables 1, 2, and 2A summarize these costs.

The local sponsors have agreed on a 5-year installation period. The estimated obligation of total project funds, including land treatment and structural measures for each fiscal year during the installation period is as follows:

	P. L. 566 Funds		Other Funds		
Year	Structural Measures	Land Treatment	Structural Measures	Land Treatment	Total
1	183,759	14,188	57,406	44,066	299,419
2	120,658	14,188	3,840	44,067	182,753
3	64,906	14,189	348	44,066	123,509
4	66,443	14,188	6,066	44,067	130,764
5	74,437	14,189	1,106	44,067	133,799
	510,203	70,942	68,766	220,333	870,244

EFFECTS OF WORKS OF IMPROVEMENT

Reduction of Floodwater Damage

The project will afford benefits on 729 acres of bottomlands. The acres inundated by expected frequency intervals are shown below:

	2 year	3 year	5 year	10 year	50 year	100 year
Without Project	534	549	597	645	713	729
With Project	0	0	21	115	455	499

Other benefits will accrue to certain undetermined areas of flood plain on the Banister River and areas above the 100-year frequency elevation of Cherrystone Creek. However, these areas were not measured or used in the economic justification of this project.

The installation of this project will accomplish the stated objectives of the sponsoring local organization. The proposed land treatment and structural measures will adequately protect 641 acres of agricultural flood plain land and 88 acres of land zoned for industry in and adjacent to the Town of Chatham. This project will

permit the landowners to more fully and efficiently use and develop their flood plain land. The land at Chatham, which is located adjacent to a side track to the main line of the Southern Railroad, may safely be developed for industry. This will add greatly to the development of the economy of the area. The project will also result in greatly reduced damages to improvements such as businesses, roads, bridges, farm fences, etc.

There will be no increase in the acreage of cultivated cropland in the watershed. Needed land use adjustments will be made so that land can be used according to its capabilities and treated according to its needs. Five hundred forty-three acres of flood plain can be restored to its former productivity or used more intensively.

When the project is installed some 50 present landowners will receive direct identifiable benefits. The other approximately 4,550 people in the watershed will enjoy the benefits of fewer traffic interruptions, less loss of income due to flooded businesses, reduced sediment load in the stream and increased economic growth.

Reduction of Sediment

The proposed forest land treatment measures will reduce the rate of erosion from certain sediment producing forest lands. This in turn will reduce sediment contribution to the sediment damage area.

Land treatment measures on open land will reduce the rate of erosion on the uplands and thereby reduce the sediment contribution in the flood plain area. The trap efficiency of the floodwater retarding structures will also reduce the sediment contribution. The combined effects of the floodwater retarding structures and stream channel improvements will reduce the area subject to damage. Overall, sediment damage will be reduced approximately 90 percent.

Reduction of Erosion

The damage from scour erosion on the flood plain will be lessened by reducing the stages and velocities of overbank flows and reduced area flooded for any given storm. These damages will be reduced about 53 percent.

Non-Agricultural Water Management

The non-agricultural water supply storage for municipal use will benefit the entire Town of Chatham and adjacent area having a present population in excess of 2,500 people. This storage will provide an abundance of good quality water for drinking and other household purposes as well as an adequate supply to allow the planned industrial and urban growth in and around Chatham.

PROJECT BENEFITS

Monetary Benefits

The combined land treatment and structural measures will reduce average annual damages within the watershed about 98 percent. The average annual value of this reduction is $12,333 of which $370 is attributed to land treatment measures and $11,963 to structural measures. The floodwater benefits to crops and pasture total $6,122 annually, of which $5,685 is the result of restoration of former productivity level and is included as a crop and pasture damage in Table 5. Benefits to agricultural improvements in the flood plain amount to $87 annually and result from reduction of damages to fences, farm roads, water gates, and other minor fixed improvements. The benefits from sediment and erosion damage reduction totals $924 annually. The benefits from reduction of damage to roads, bridges and railroads are estimated at $1,478. Benefits to reduction of damages to major improvements are estimated at $2,253 annually. More intensive use of the agricultural flood plain land is estimated at $4,927 after allowing for the associated increased costs of production. Incidental recreation benefits result from the use of the sediment pools by organized groups and the general public for fishing and amount to $1,558 annually. Benefits to the project from reduced replacement and installation costs of roads and bridges and planned commercial development amounts to $613 annually. This is based on information provided by the Highway Department and companies owning flood plain property with plans for construction of buildings within the next five years with or without the project.

Local secondary benefits induced by the project are considered to be equal to 10 percent of the increased costs that primary producers will incur in connection with increased production and will amount to $1,004 annually. These benefits include the increased net return to suppliers of farm equipment and supplies, increased net income to local retailers and wholesalers from consumer expenditures by the families resulting from increased farm income and other expenditures resulting from the returns from costs directly associated with marketing or using project goods and services.

Local secondary benefits stemming from the project are considered to be 10 percent of the direct primary project benefits and total $2,283 annually. The increased production of agricultural products due to restoration of productivity and more intensive use will require additional labor for production, harvesting and marketing. These items will make greater use of transportation, processing and marketing facilities; tending to increase both agricultural and general business activities. Reduced flooding in businesses and additional non-farm development of portions of

the flood plain with the project installed will reduce business and industrial shut downs due to flooding and make possible the development of a very desirable industrial area and increase the efficiency of both agricultural and non-agricultural operations in the benefited area. This will provide more employment opportunities and general economic growth.

Secondary benefits from a national viewpoint were not considered pertinent to the economic evaluation of this watershed.

Indirect benefits are estimated to be 10 percent of the damage reduction benefits to crops and pasture and 20 percent of the other direct damage reduction benefits and amount to $1,469 annually.

Reach II and the downstream portion of Reach I is in, or adjacent to, the Town of Chatham. Railroad and highway facilities as well as water and electricity are available. The utilization of this flood plain land for urban and industrial use is expected to provide $6,420 annual flood prevention benefits.

Benefits Not Measured in Monetary Terms

The reduced margin of profit on agricultural products and repeated flood damages have materially reduced the income in this watershed, and in turn the economic welfare of the area has suffered. The project will stimulate the agriculture and general business and industry of the area, helping to create full employment and a growing economy. By making available additional good quality water the existing businesses and industries will be provided with a basic facility for expansion of their operations. Also, with an adequate water supply, the community will be in a better position to attract new industries and businesses. The project will also make possible greater development of the recreation potential of the watershed.

COMPARISON OF BENEFITS AND COSTS

The estimated average annual cost for the structural measures is $21,531. The average annual primary benefits from the planned structural measures, not including local secondary benefits, are estimated to be $27,581; giving a benefit-cost ratio of 1.3 to 1.0. The inclusion of local secondary benefits increases the estimated average annual benefits to $30,868 and the benefit-cost ratio to 1.4 to 1.0.

PROJECT INSTALLATION

An installation period of 5 years has been established for the Cherrystone watershed. Land treatment measures on open lands will be installed, operated and maintained by the landowners or operators under agreements with the Pittsylvania Soil and Water

Conservation District, with technical assistance furnished by the Soil Conservation Service.

The forest land treatment measures will be installed by the landowners with technical assistance furnished by the Virginia Division of Forestry, in cooperation with the U. S. Forest Service.

The Pittsylvania Soil and Water Conservation District and the Town of Chatham, Virginia, will be responsible for the successful application of this watershed plan. Their responsibility will be supplemented by memoranda of understanding and cooperative agreements with other agencies and organizations.

To stimulate interest in watershed activities the Agricultural Extension Service will assist the sponsoring local organizations in developing and carrying out an information and educational program.

The Pittsylvania Soil and Water Conservation District, with the assistance of the Soil Conservation Service technicians, will assist cooperating landowners and operators in the preparation and application of conservation plans on privately-owned land.

The Pittsylvania County Agricultural Stabilization and Conservation Service County Committee, through the Agricultural Conservation Program, will assist in accelerating the completion of the planned land treatment measures. This assistance will be in the form of approval of requests for ACP cost-sharing for land treatment practices to be carried out on farms within the watershed. Assistance will, of necessity, be limited by the amount of funds available under the ACP. The amount of assistance furnished will also be influenced by the needs and desires of the landowners.

The installation costs for roadside erosion control measures will be the responsibility of the sponsors. However, through agreement, the Virginia Department of Highways will perform the installation. The Service will provide the funds for the purchase of materials used for these measures.

The Pittsylvania Soil and Water Conservation District, the Soil Conservation Service, the Virginia Division of Forestry, with the U. S. Forest Service cooperating, and the ASCS County Committee will contribute to these plans by taking into consideration the needs of the watershed in approving ACP cost-sharing by setting up an annual reserve of funds for this purpose.

The Virginia Commission of Game and Inland Fisheries will furnish assistance and planting materials for the development and improvement of wildlife food and cover. The Commission will also furnish guidance in wildlife management.

The proposed sequence of installation of structural measures is as follows: multiple-purpose structure number 1, floodwater retarding structure number 2, stream channel improvements in Reach II, floodwater retarding structure number 3 and stream channel improvements in Reaches III and IV.

The Soil Conservation Service will provide technical services for design and layout of the floodwater retarding structures, sites number 2 and 3, and stream channel improvements, and will provide funds for construction as authorized under Public Law 566, 83d Congress, as amended. The Town of Chatham intends to request that the Service prepare the design and layout for the multiple-purpose structure, dam number 1, as in accordance with Soil Conservation Service Engineering Memorandum 54 (Revised), May 18, 1964.

The Town of Chatham, Virginia, will provide 18.39 percent of the design, layout and joint construction costs for the multiple-purpose dam, number 1, in order to incorporate 850 acre-feet of water for municipal water storage in the site. The Service will provide 81.61 percent of the design, layout and joint construction costs of dam number 1 from funds provided under Public Law 566, 83d Congress, as amended.

The Town of Chatham will be responsible for obtaining, without cost to the Federal government, all easements and rights-of-way for the multiple purpose structure, dam number 1. The Pittsylvania Soil and Water Conservation District will be responsible for obtaining, without cost to the Federal government, all easements and rights-of-way for all other structural works of improvement.

The Town of Chatham will be responsible for the operation and maintenance of the multiple-purpose structure, dam number 1. The Pittsylvania Soil and Water Conservation District will be responsible for the operation and maintenance of all other works of improvement in the watershed.

Federal assistance for carrying out the works of improvement as described in this work plan will be provided under the authority of Public Law 566, 83d Congress, 68 Stat. 666, as amended.

FINANCING PROJECT INSTALLATION

The installation costs for land treatment measures, other than critical area treatment, will be the responsibility of the landowners. Advantage will be taken of cost-sharing under the Agricultural Conservation Program (ACP) and other programs insofar as possible.

The installation costs of roadside erosion control measures will be the responsibility of the sponsors. However, through a

secondary agreement with the sponsors, the Virginia Department of Highways will perform the installation. They will do the necessary grading, seeding, and mulching on the treated areas (estimated cost $29,109).

There will be $48,683 available from P. L. 566 funds for technical assistance for land treatment measures on open land of which $9,600 is needed for soil surveys. An estimated $11,259 will be provided from P.L. 566 funds for materials for the roadside erosion control. The furnishing of these funds will be contingent upon satisfactory accomplishment of this work by the Highway Department.

The total cost of installing forest land treatment measures is estimated to be $62,700. Technical assistance to forest landowners for the installation of these measures will cost $22,000. This amount will be shared equally by the State and Federal government through the P.L. 566 program. The remaining $40,700 includes $500 to be contributed by the State for tree seedlings furnished landowners and $40,200 as installation costs to the landowners. It is expected that the Agricultural Conservation Program cost-sharing will be available to qualified landowners for installing these measures.

The total installation cost of the structural measures is estimated to be $578,969 of which P.L. 566 funds will bear $510,203 and others $68,766. The Town of Chatham does not anticipate the necessity of securing a Watershed Development Loan from the Farmers Home Administration to assist in carrying out their financial responsibilities in construction of this project.

The structural measures in this work plan are grouped in two construction units. Prior to providing federal financial assistance for the construction of any structural works of improvement within a construction unit, the sponsoring local organization must obtain all necessary land, easements and rights-of-way for all structural measures within that unit. The structural measures in the first construction unit are identified in Table 7, all other measures are in the second construction unit. Legal costs will be shared by the sponsors and the Virginia Soil and Water Conservation Commission.

This work plan does not constitute a financial document to serve as a basis for the obligation of federal funds, and financial and other assistance to be furnished by the Soil Conservation Service in carrying out the watershed work plan is contingent on the appropriation of funds for this program.

PROVISIONS FOR OPERATION AND MAINTENANCE

The Town of Chatham will assume the responsibility for the operation and maintenance of the multiple-purpose structure (dam number 1) at an estimated cost of $700 annually. This maintenance will consist mainly of fertilizing, liming, mowing the fills and spillways, seeding and mulching bare areas, painting the trash racks and repairing gullies that might occur in the dam areas and care and operation of the head gates regulating the municipal water supply flow.

The Pittsylvania Soil and Water Conservation District will assume the responsibility for the operation and maintenance of all other structural works of improvement at an estimated cost of $1,865 annually. This will consist of maintenance of dams number 2 and 3 and the stream channel improvements. The maintenance of channel improvements will consist of keeping the brush removed from the banks and removing bars and debris from the channel that might hinder channel flow. Maintenance of the dams will consist primarily of fertilizing, liming and mowing the fills and spillways, seeding and mulching bare areas, painting the trash racks and repairing gullies that might occur in the dam areas.

The responsibility will be implemented by maintenance agreements with the landowners. In the event of default by the landowners, the Virginia Soil and Water Conservation Commission of the Commonwealth of Virginia will assist the District within the polidy of the following quoted resolution:

> "Be it resolved by the Virginia Soil and Water Conservation Commission that it is the policy of this State Agency to do everything within its legal power and financial ability to see that watershed projects developed under the authority of Public Law 566, as amended, and Public Law 534, as amended, are maintained by the local soil and water conservation districts. Under appropriate conditions the Commission will assist in the maintenance of said projects, should it be demonstrated that the local district is unable to maintain such works of improvement. It is understood that the powers, duties, and appropriations of the Virginia Soil and Water Conservation Commission are subject to being changed by the General Assembly of Virginia."
>
> Authority for this policy is contained in SOIL AND WATER CONSERVATION DISTRICTS LAW, Title 21, Chapter 1, Sec. 21-10. "Duties in General. In addition to the duties and powers hereinafter conferred upon the Virginia Soil and Water Conservation Commission, it

> shall have the following duties and powers: (Item 1) To offer as a gift or loan such financial and other assistance as may be appropriate to the Supervisors of Soil and Water Conservation Districts, organized as provided hereinafter, in the carrying out of any of their powers and programs."

The structural measures will be inspected at least annually or after each major storm by representatives of the sponsors and the Soil Conservation Service to see that they are properly maintained.

The forest land treatment measures will be operated and maintained by the landowners with technical assistance furnished by the Virginia Division of Forestry in cooperation with the U. S. Forest Service. The going federal-state cooperative forestry programs will continue to contribute to the program after the installation period.

Maintenance of the roadside erosion control measures will be the responsibility of the Pittsylvania Soil and Water Conservation District; however, the measures will actually be maintained by the Virginia Department of Highways through a memorandum of understanding between the District and the Department of Highways.

All other land treatment measures will be maintained by the local landowners under cooperative soil and water conservation agreements with the District.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST Sheet 1

Cherrystone Watershed, Virginia

Installation Cost Item	Unit	Number to be Applied	Estimated Cost (Dollars) 1/ Non-Federal P.L. 566	Land Other	TOTAL
Land Treatment					
Soil Conservation Service					
Cropland	Ac.	4,130		55,200	55,200
Grassland	Ac.	4,101		83,630	83,630
Miscellaneous Land	Ac.	1,249		3,000	3,000
Critical Area Planting	Ac.	47	11,259	17,850	29,109
Technical Assistance			48,683 2/	8,953	57,636
SCS Subtotal			59,942	168,633	228,575
Forest Service					
Woodland	Ac.	5,160		40,700	40,700
Technical Assistance			11,000	11,000	22,000
FS Subtotal			11,000	51,700	62,700
TOTAL LAND TREATMENT			70,942	220,333	291,275

1/ Price Base: Current

2/ Includes $9,600 for accelerated Soil Surveys.

[illegible]

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST Sheet 2
Cherrystone Watershed, Virginia

Installation Cost Item	Unit	Number to be Applied	Estimated Cost (Dollars) 1/ Non-Federal P.L. 566	Land Other	TOTAL
STRUCTURAL MEASURES					
Soil Conservation Service					
Floodwater Retarding Structures	No.	2	144,104		144,104
Multiple-purpose Struc.	No.	1	150,501	38,414	188,915
Stream Channel Impr.	Mi.	5.55	106,481		106,481
Dike	Ft.	570	561		561
SCS Subtotal			401,647	38,414	440,061
Subtotal - Construction			401,647	38,414	440,061
Installation Services					
Soil Conservation Service					
Engineering Services			77,533	5,127	82,660
Other			31,023	2,367	33,390
SCS Subtotal			108,556	7,494	116,050
Subtotal-Installation Services			108,556	7,494	116,050
Other Costs					
Adm. of Contracts				1,945	1,945
Land, Easements & R/W				20,913	20,913
Subtotal - Other				22,858	22,858
TOTAL STRUCTURAL MEASURES			510,203	68,766	578,969
TOTAL PROJECT			581,145	289,099	870,244
SUMMARY					
Subtotal SCS			570,145	237,399	807,544
Subtotal FS			11,000	51,700	62,700
TOTAL PROJECT			581,145	289,099	870,244

1/ Price Base: Current

Date February 1965

TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT
(at time of Work Plan Preparation)
Cherrystone Watershed, Virginia

Measures	Unit	Applied to date	Total Cost (Dollars) 1/
LAND TREATMENT			
Soil Conservation Service			
Conservation Cropping Systems	acres	4,000	40,000
Contour Farming	acres	3,000	36,000
Cover Crops	acres	540	5,400
Crop Residue Use	acres	2,000	20,000
Irrigation Storage Reservoir	number	50	37,500
Irrigation Water Management	acres	180	900
Land Clearing	acres	500	25,000
Drains-Mains or Laterals	feet	10,560	3,168
Row Arrangement	acres	50	100
Stripcropping-Contour	acres	200	2,400
Plow Planting	acres	100	600
Terrace - Gradient	feet	158,400	11,088
Grasses & Legumes in Rotation	acres	700	7,000
Grassed Waterways	acres	50	10,000
Pasture & Hayland Planting	acres	1,000	60,000
Pasture & Hayland Renovation	acres	500	27,000
Pasture - Proper Use	acres	600	15,000
Rotational Grazing	acres	600	600
Farm Ponds	number	50	12,500
Wildlife Habitat Development	acres	50	3,750
Subtotal SCS			318,006
Forest Service*			
Tree Planting	acres	220	6,955
Hydrological Cultural Operations	acres	200	4,335
Subtotal FS			11,290
GRAND TOTAL	XXX	XXX	329,296

*Accomplishments during last 10 years.

1/ Price Base: Current

Date February 1965

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Cherrystone Watershed, Virginia

(Dollars) 1/

Structure Site No. or Name	Installation Cost-P.L. 566 Funds				Installation Cost-Other Funds					Total Inst. Cost
	Construction	Instal.Services Engineering	Other	Total P. L. 566	Construction	Instal-lation Services	Adm. of Cont.	Ease-ments & R/W	Total Other	
Site No. 1	150,501	22,756	10,502	183,759	33,914	7,494	823	10,675	52,906	236,665
Headgates & Catwalks					4,500				4,500	4,500
Site No. 2	92,930	20,138	7,590	120,658			415	3,425	3,840	124,498
Site No. 3	51,174	11,089	4,180	66,443			228	5,838	6,066	72,509
Stream Channel Impr.	106,481	23,428	8,705	138,614			474	925	1,399	140,013
Dike	561	122	46	729			5	50	55	784
GRAND TOTAL	401,647	77,533	31,023	510,203	38,414	7,494	1,945	20,913	68,766	578,969

1/ Price Base: Current

Date February 1965

TABLE 2A - COST ALLOCATION AND COST SHARING SUMMARY

Cherrystone Watershed, Virginia

(Dollars) 1/

Item	Purpose		Total
	Flood Prevention	Water Supply	
COST ALLOCATION			
Single Purpose	337,804		337,804
Multiple Purpose	193,142	48,023	241,165
Total	530,946	48,023	578,969
COST SHARING			
P.L. 566	510,203		510,203
Other	20,743	48,023	68,766
Total	530,946	48,023	578,969

1/ Price Base: Current

Date February 1965

TABLE IV - COST ALLOCATION AND COST [illegible]

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

TABLE 3 - STRUCTURE DATA
FLOODWATER RETARDING STRUCTURES AND WATER SUPPLY RESERVOIRS
Cherrystone Watershed, Virginia

Item	Unit	STRUCTURE NUMBER 1	2	3	Total
Drainage Area	sq.mi.	14.7	5.70	3.96	24.36
Storage Capacity					
Sediment in Sediment Pool	ac.ft.	242	116	93	451
Sediment above Perm. Pool	ac.ft.	158	114	84	356
Total Sediment	ac.ft.	400	230	177	807
Floodwater	ac.ft.	3372	1003	634	5009
Water Supply	ac.ft.	850 2/	-	-	850
Total	ac.ft.	4622	1233	811	6666
Between high & low stages	ac.ft.	1176	304	296	1776
Surface Area					
Sediment Pool	ac.	52	15	17	84
Floodwater Pool	ac.	256	70	70	396
Water Supply Pool	ac.	105	-	-	105
Volume of Fill	cu.yds.	152,602	64,352	36,434	253,388
Elevation Top of Dam	ft.	692.7	706.7	630.7	XXX
Maximum Height of Dam	ft.	50.7	63.2	32.7	XXX
Emergency Spillway					
Crest Elevation	ft.	682.1	700.1	626.8	XXX
Bottom Width	ft.	135	200	150	XXX
Type	-	Veg.	Veg.	Veg.	XXX
Percent Chance of Use	-	1	1	2	XXX
Ave. Curve No. - Cond. II	-	65	66	66	XXX
Emergency spillway hydrograph					
Storm Rainfall (6-hr.)	in.	10.72	11.10	7.50	XXX
Storm Runoff	in.	6.19	6.66	3.60	XXX
Velocity of Flow (V_c) 1/	ft/sec.	7.3	8.2	2.9	XXX
Discharge Rate 1/	c.f.s.	1850	3160	112	XXX
Max. w.s. elev. 1/	ft.	685.3	703.8	627.4	XXX
Freeboard Hydrograph					
Storm Rainfall (6-hr.)	in.	20.08	17.60	11.90	XXX
Storm Runoff	in.	14.81	12.64	7.38	XXX
Velocity of Flow (V_c) 1/	ft/sec.	13.8	11.2	8.3	XXX
Discharge Rate 1/	c.f.s.	14310	9600	3000	XXX
Max. w.s. elev. 1/	ft.	692.7	706.7	630.7	XXX
Principal Spillway					
Capacity-low stage	c.f.s.	170	68	53	XXX
Capacity-high stage	c.f.s.	367	200	110	XXX
Capacity Equivalents					
Sediment volume	in.	.51	.76	.84	XXX
Detention volume	in.	4.30	3.30	3.00	XXX
Spillway storage	in.	3.97	1.64	1.42	XXX
Class of structure		b	b	a	XXX

1/ Maximum during passage of hydrograph.
2/ Town consumption.

Date February 1965

Channel Name	Station	D. A. (sq.mi.)	Req'd. Cap. (cfs)	Area Design (sq.ft.) O.B. Seg.	Cap.at Design Depth (cfs)	Volume of Excav. Earth 1000 c.y.	Volume of Excav. Rock 1000 c.y.	Stab.check as-Constr. Conditions Flow (cfs)	Stab.check as-Constr. Conditions Vel. (fps)
Main Stem	1/138+00		Upper Limit						
	157+88	26.95	2360	-	2448	25.2	-	733	3.7
	170+28	27.25	2400	-	2580	12.3	-	745	3.6
	180+04	27.34	2420	-	2668	10.1	-	752	3.6
	2/189+80	27.46	2450	-	2554	4.9	3.0	760	3.4
	202+00	27.51	2470	-	2668	6.7	-	768	3.1
	3/208+00	27.56	2490	-	2492	6.4	0.3	771	2.4
	227+30	31.78	578	-	596				
	236+90	31.90	602	-	603	1.2			
	256+71	32.28	620	-	626	5.8			
	267+36	33.36	676	-	690	3.0			
	277+65	33.99	694	-	714	2.3			
	307+85	34.55	742	-	738	9.4			
	4/315+50	36.85	856	-	874	5.2			
	329+76	37.16	864	-	868	7.1			
	345+86	37.51	872	-	879	11.5			
	361+53	38.14	880	-	896	13.9			
	383+45	38.52	890	-	888	12.3			
	441+40	39.46	896	-	897	20.9			
	450+45	45.94	1285	-	1360				

1/ 100 year 6-hour channel from station

2/ Outletting 100 year 6-hour channel in from station 189+80 to 208+00.

3/ 3 year 6-hour channel from station 20

4/ Channel designed from station 315+50

Date February 1965

USDA-SCS-HYATTSVILLE, MD, 1965

TABLE 3A - STRUCTURE DATA
CHANNELS
Cherrystone Watershed, Virginia

Channel Name	Station	D. A. (sq.mi.)	Req'd. Cap. (cfs)	Manning's "N" Value Present	Manning's "N" Value Design	Bottom Width (ft.)	Side Slopes	Hydraulic Gradient (ft/ft.)	Water Surface Elev. (m.s.l.)	Design Depth (ft.)	Velocity at Design Depth (fps) Chan. Seg.	Velocity at Design Depth (fps) O.B. Seg.	Flow Area at Design Depth (sq.ft.) Channel Seg.	Flow Area at Design Depth (sq.ft.) O.B. Seg.	Cap.at Design Depth (cfs)	Volume of Excav. Earth 1000 c.y.	Volume of Excav. Rock c.y.	Stab.check as-Constr. Conditions Flow (cfs)	Stab.check as-Constr. Conditions Vel. (fps)
Main Stem	1/138+00		Upper Limit of Channel Work						609.0										
	157+88	26.95	2360	.068	.030	45	1½:1	.00172	605.6	7.0	6.3	-	388.5	-	2448	25.2	-	733	3.7
	170+28	27.25	2400	.070	.030	48	1½:1	.00172	603.5	7.0	6.3	-	409.5	-	2580	12.3	-	745	3.6
	180+04	27.34	2420	.070	.030	50	1½:1	.00172	601.7	7.0	6.3	-	423.5	-	2668	10.1	-	752	3.6
	2/189+80	27.46	2450	.070	.030	50	1:1	.00172	600.1	7.0	6.4	-	399.0	-	2554	4.9	3.0	760	3.4
	202+00	27.51	2470	.070	.030	50	1½:1	.00172	599.3	7.0	6.3	-	423.5	-	2668	6.7	-	768	3.1
	3/208+00	27.56	2490	.070	.030	46	1½:1	.00168	597.0	7.0	6.3	-	395.5	-	2492	6.4	0.3	771	2.4
	227+30	31.78	578	.070	.040	B&S		.00233	592.5	6.4	4.2	-	142.0	-	596				
	236+90	31.90	602	.072	.040	17	1½:1	.00152	590.9	6.2	3.7	-	163.1	-	603	1.2			
	256+71	32.28	620	.072	.040	18	1½:1	.00152	587.9	6.2	3.7	-	169.3	-	626	5.8			
	267+36	33.36	676	.072	.040	20	1½:1	.00152	586.3	6.2	3.8	-	181.7	-	690	3.0			
	277+65	33.99	694	.072	.040	21	1½:1	.00152	584.7	6.2	3.8	-	187.9	-	714	2.3			
	307+85	34.55	742	.067	.040	22	1½:1	.00152	580.6	6.2	3.8	-	194.1	-	738	9.4			
	4/315+50	36.85	856	.067	.040	29	1½:1	.00168	579.0	5.7	4.0	-	218.4	-	874	5.2			
	329+76	37.16	864	.067	.040	35	1½:1	.00168	576.6	5.2	3.9	-	222.6	-	868	7.1			
	345+86	37.51	872	.075	.040	41	1½:1	.00168	574.0	4.8	3.8	-	231.4	-	879	11.5			
	361+53	38.14	880	.075	.040	50	1½:1	.00168	571.3	4.4	3.6	-	249.0	-	896	13.9			
	383+45	38.52	890	.075	.040	35	1½:1	.00168	567.6	5.3	3.9	-	227.6	-	888	12.3			
	441+40	39.46	896	.069	.040	26	1½:1	.00168	559.7	6.2	4.1	-	218.9	-	897	20.9			
	450+45	45.94	1285	.069	.040	B&S		.00168	556.8	6.2	5.0	-	272.0	-	1360				

1/ 100 year 6-hour channel from station 138+00 to station 189+80.

2/ Outletting 100 year 6-hour channel into 3 year 6-hour channel with least amount of backwater effect from station 189+80 to 208+00.

3/ 3 year 6-hour channel from station 208+00 to station 450+45.

4/ Channel designed from station 315+50 to station 383+45 so as not to disturb a large shallow pipe line.

Date February 1965

USDA-SCS-HYATTSVILLE, MD, 1965

TABLE 3B - STRUCTURE DATA

DIKE - DIVERSION

Cherrystone Watershed, Virginia

Type	Length (ft.)	Ave. Ht. (ft.)	Vol. Fill (cu.yds.)	Design Discharge (cfs)	Diversion Grade (ft/ft.)
Diversion	570	4.0	911	2,340	0.005

Date February 1965

TABLE 4 - ANNUAL COST

Cherrystone Watershed, Virginia

(Dollars) 1/

Evaluation Unit	Amortization of Installation Cost 2/	Operation and Maintenance Cost	Total
All Structural Measures	18,967	2,564	21,531
TOTAL	18,967	2,564	21,531

1/ Price Base: Installation Cost-Current; Operation & Maintenance Cost long-term projected based on Agricultural Price and Cost Projections, September 1957.

2/ Installation cost amortized 100 years at 3-1/8 percent interest.

Date February 1965

TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Cherrystone Watershed, Virginia

(Dollars) 1/

Item	Estimated Average Annual Damage: Without Project	With Project	Damage Reduction Benefit
Floodwater			
Crop and Pasture	6,172	50	6,122
Other Agricultural	97	10	87
Nonagricultural			
Roads and Bridges	1,512	34	1,478
Major Fixed Improvements	2,253	0	2,253
Subtotal	10,034	94	9,940
Sediment			
Overbank Deposition	933	96	837
Subtotal	933	96	837
Erosion			
Floodplain Scour	164	77	87
Subtotal	164	77	87
Indirect	1,500	31	1,469
Total	12,631	298	12,333

1/ Price Base: Long Term as projected by Agricultural Research Service, September 1957.

Date February 1965

TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Cherrystone Watershed, Virginia

(Dollars) 1/

Evaluation Unit	AVERAGE ANNUAL BENEFITS								Average Annual Cost	Benefit Cost Ratio
	Flood Prevention									
	Damage Reduction	More Intensive Land Use	Urban Enhancement	3/ Other	Incident. Recreation	Local Secondary	Municipal Water Storage	Total		
All Structural Measures	11,963	4,927	6,420	613	1,558	3,287	2,100	30,868	21,531	1.4:1.0
GRAND TOTAL	11,963 2/	4,927	6,420	613	1,558	3,287	2,100	30,868	21,531	1.4:1.0

1/ Price Base: Costs: Current; Benefits - Long term projected based on Agricultural Price and Cost Projections, September 1957.

2/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of $370 annually.

3/ Reduced construction costs for planned industrial development and replacement of roads and bridges.

Date February 1965

TABLE 7 - CONSTRUCTION UNITS

Cherrystone Watershed, Virginia

(Dollars) 1/

Measures in Construction Unit	Annual Benefit	Annual Cost
Dams 1 and 2 and Reach II Channel Improvements and Dike	25,383	14,117

1/ Price Base: Current

Date February 1965

INVESTIGATIONS AND ANALYSES

General

The project objectives dictated the type and extent of investigations and analyses needed for development of a work plan for this watershed. It was decided that in keeping with the desires of the sponsors, the intent of the law, and Soil Conservation Service policy, a watershed project should be developed that would give protection to the agricultural flood plain from a 3-year frequency storm and 100-year frequency protection to the area at Chatham zoned for industry. Also the Town of Chatham desired to include municipal water storage in one site.

With these desires in mind, a reconnaissance study was made to determine the most feasible location for structure sites to give protection to the greatest amount of flood plain and provide the desired water storage for Chatham.

In the selection of structural works of improvement, preliminary findings indicated that maximum use of floodwater retarding structures would be essential. It was recognized that stream channel improvements would also be necessary.

Land Treatment Measures

Additional land treatment measures were planned in accordance with the capabilities of the land to reduce erosion and sedimentation. Field investigations were made of road banks in the watershed, and an on-site determination was made as to whether or not the areas were actively producing sediment. On each actively eroding area, a record was made of the length and width of the eroding areas to determine the area treated. These determinations were made by Service personnel and representatives of the Virginia Department of Highways. The remainder of the problem areas in the watershed were considered to be of such proportion as to be adequately cared for by accelerated installation of the planned land treatment measures and the tree planting and other forestry measures recommended by the Forest Service.

Information on the hydrologic condition of the forest land was collected in a series of field plots, selected systematically. Measurements of litter, humus, soil type and other hydrologic factors were recorded and analyzed.

Alternatives Considered

During the preliminary stage of investigation damsites, other than the ones in this plan, were considered. A site on Little Cherrystone Creek could not be justified on its own tributary, and the

tributary's confluence with the main stem is too near the lower end of the watershed to get any benefits from the main stem. Each of the two small tributaries aboue highway 57 were investigated for possible damsites. Field observation did not reveal any good sites. Any location on either tributary would give poor storage and very small additional control. Any location on one tributary would involve the Southern Railroad.

The channel design was originally made with breaks in grade following the natural breaks of the channel in an attempt to excavate the least amount of material. Then it was made with the least number of breaks in grade to give a more efficient channel. The 100-year portion of the channel was first made to outlet at the upper end of a gorge area of the flood plain. A check with water surface profile computations indicated a back water condition caused by the gorge, even though the channel bottom gradient through the gorge was steeper than that of the designed channel upstream. This backwater condition would tend to make the 100-year storm flow out-of-bank into the lower end of the industrial development area. Since this would take away from the benefit area, the 100-year channel design was extended through the gorge and made to outlet into a wider area. Below this new outlet for the 100-year channel would be a 3-year channel design for agricultural flood plain. A check with water surface profile computations from the three year channel upstream would give a backwater condition back into the gorge. This alternative, however, would not put the 100-year storm out-of-bank above the gorge, and therefore the industrial development area would have 100-year protection.

The 3-year channel in reach IV was designed with a constant depth of 6.2 feet for the first alternative. With this design, the three pipes of the TRANSCO gas line would have to be lowered in order to put them clear of the channel bottom. The second alternative uses the same channel design except at the pipeline crossing. A constant hydraulic grade line was used across the pipeline. The channel depth and bottom width were allowed to vary until the bottom of the channel cleared the pipes. This would mean that the channel depth would decrease downstream to the pipeline and then increase again, while the width would increase to the pipeline and then decrease again. This is not the most efficient channel design from an excavation standpoint, but would cost less than lowering the pipes.

Economic Investigations

Determination of Annual Benefits from Reduction in Damages - Agricultural damage estimates were based on interviews with farm operators controlling about 75 percent of the flood plain area below structures. These interviews covered land use, crop

distribution, average yields and experienced flood damages. Further information on flood plain land use was developed by field delineation of the present land use on a flood plain strip map and planimetering the area for each land use. Information obtained from these interviews was summarized and used with other data to develop projected damage rates and values for crops by seasons and depth of flooding. The applicable rates of damage were applied to acreage inundated, as shown by hydrologic data, to determine average annual damage by the frequency method. The flood plain land use and estimates of normal yields of crops were based on information obtained from the interviews supplemented by information obtained from work unit personnel, other agricultural workers in the area and general agricultural projections made for the county.

Costs of producing crops, pasture and other farm products were obtained locally and from experiment station data. All installation costs were based on current prices. All costs of production and benefits were based on long term projected prices as projected by Agricultural Research Service, September 1957.

Damages to homes and other buildings in the flood plain were obtained from interviews. Existing properties were located on a strip map of the flood plain and elevations established during the field engineering surveys. Damagesto public roads and bridges were obtained from the Virginia Department of Highways.

Non-agricultural damages were related to a storm which occurred in August 1955. Monetary damage estimates were made atone-foot intervals above and below the stage of this storm. A field inspection of the affected properties was made to determine the point at which damage begins. Damage schedules were obtained for all business and industrial properties subject to flooding by the 100-year frequency storm. Using information from the hydrologist, as determined from valley cross-sections and water surface profile data, a stage-damage curve was constructed for each reach for major fixed improvements and roads and bridges. Using this data, a damage-frequency curve was prepared for each reach for each major type of damage.

The monetary value of the average annual damage was obtained by use of the damage-frequency curve for "without project" and with the proposed works of improvement. The average annual damage reduction benefits were considered to be the difference between the estimated damage without the project and with the project.

Estimates of erosion and sediment damage were developed using procedures described in the Economics Guide for Watershed Planning and the Watershed Protection Handbook.

Indirect damages to crops and pasture in the flood plain were determined to be at least 10 percent of the direct damages. The indirect damages to flood plain improvements, including the urban area, roads, bridges, fences, farm roads, etc., were estimated to be 20 percent of the direct damages to these improvements.

Additional factors considered in these analyses were: size and location of affected farms, land capability, existence of markets and managerial skill of operations.

Easement costs for the works of improvement were determined by the committee of the sponsoring local organizations based on land sales and appraisals of similar land in the community.

The methods of economic evaluation conform to those set up in the Economics Guide for Watershed Protection and Flood Prevention prepared by the Soil Conservation Service, March 1964.

Benefits from Restoration of Former Productivity - The difference in net income now being received and that which is expected to prevail under restored conditions is considered as a benefit from restoration of former productivity. These benefits were calculated by summarizing land use, acreages, yields and net income by reach as described in the Economics Guide for watershed planning, Chapter 4. The total increased net income expected to accrue to restoration to former productivity after allowance for associated costs, increased flood damages and a 5-year lag period amounts to $5,685 annually. This amount was considered to be a present crop and pasture damage and was so shown in Table 5.

More Intensive Land Use Benefits - These benefits are described in Chapter 4, page 1 of the Economics Guide as "an intensification of present use" of crop and pasture land. This takes into consideration the increased level of income due to greater production of crops by using improved varieties, larger amounts of fertilizer and other practices made possible by the reduced flood hazard. This benefit also considers shifting the land from such use as unimproved pasture to silage, or some other higher value crop. It is estimated that these benefits will amount to $4,927 annually after allowing for a 5-year lag in accrual and increased cost of production.

The installation of works of improvement making possible these benefits will not result in an increased acreage of surplus crops. The increased acreage of cropland in the flood plain will result from moving crops from the erosive uplands to the more desirable flood plain. Also, with the expected increased emphasis in livestock and poultry, these crops will be used mainly for consumption by the livestock on the farm on which they are grown.

The monetary appraisal of the physical damages from sediment and erosion of the flood plain was based on lost or deferred agricultural income. The benefits were based on the reduction in sediment, reduced area flooded, and reduced velocities and depths of floodwaters on the areas flooded, following procedures outlined in the Economics Guide for Watershed Protection and Flood Prevention and Engineering and Watershed Planning Unit, Upper Darby, Pennsylvania, Economics Memorandum No. 5 - Watershed Protection Land Damage, March 29, 1960.

Industrial Enhancement Benefits - These benefits are described in Chapter 4, pages 1 and 2 of the Economics Guide as "Enhancement-type benefits" to non-agricultural areas as a result of the project. The annual equivalent of the increased value of the land was the method used to develop the monetary value of these benefits. This takes into consideration that flood protection may permit business or industrial development of flood plain areas where this development is not feasible without protection. It is estimated that these benefits will amount to $6,420 annually. The area available for industrial enhancement is summarized as follows:

Project Use	Flood plain Ac. Inund. by 100-year freq.storm (Present)	Flood plain Ac. subject to flooding by 100-yr. freq. storm With Proj. 1/	100-year pres.minus 100-year future Ac.Inund.	Present flood plain develop.	Easements & Ac. not suitable for develop. 1/	To be developed
Industrial	88	1	87	2	5	80

1/ No benefits claimed in these areas.

Benefits Due to Savings in Future Costs - These benefits are described as "reductions in future installation or replacement costs" of additional development or existing improvements. Watersheds - Economics Memorandum EWP-7, Engineering and Watershed Planning Unit, Upper Darby, Pennsylvania, May 21, 1964, describes these benefits and procedure for computation. Reduced cost of construction for roads and bridges is estimated at $449 annually and average annual savings in construction of commercial buildings is estimated to be at least $164, for a total of $613 annually.

Local Secondary Benefits - These benefits include such items as increased use of transportation, processing and marketing facilities and increased employment opportunities, computed in accordance with Watersheds Memorandum SCS-57, Washington, D. C., October 3, 1962; Evaluation of Recreation, Redevelopment, and Secondary Benefits for Economic Justification of Watershed Projects.

Incidental Recreation Benefits - These benefits are limited to the use of the permanent pools of the structures by organized groups and the general public for fishing.

Benefits to the two single purpose floodwater retarding structures were computed for a useful life of 50 years. Full benefits are estimated for the first 35 years, decreasing to zero at 50 years. Use of these lakes by fishermen was estimated at 30 visitor days per surface acre per year during the period of full use, reduced to zero at the end of 50 years.

Benefits for the multiple-purpose structure were estimated for the entire life of the project. It was estimated that one-half of the surface area of the permanent pool of this structure would be available for use by fishermen at the rate of 30 visitor days per acre per year.

These benefits are based on the assumption that these sites will be undeveloped where very little, if any, basic facilities, other than access, are provided as described in Chapter 9, Section IIC of the Economics Guide for Watershed Protection and Flood Prevention. A value of fifty cents per visitor day was used to estimate these monetary benefits.

Engineering Investigations and Analysis

The structure sites were originally located on U.S.G.S. Quadrangle sheets. They were chosen for watershed control and storage characteristics. Each site was checked by a stereoscopic study of aerial photographs. The height of each dam was estimated by the use of a storage curve computed from planimetered contours of U.S.G.S. Quadrangle sheets. This information was first used for a preliminary cost study to determine if a watershed project might be justifiable. After the preliminary investigation indicated that a project was justifiable, the final dam centerlines were more closely located in the field, giving full consideration to emergency spillway, principal spillway, fill, and other factors affecting dam costs as well as safety. The height of dams estimated in the preliminary study was used as a guide to arrive at the amount of field survey coverage needed.

Elevations above mean sea level were carried to each damsite from U.S.G.S. bench marks. Complete topographic surveys were made of the storage basins by the baseline-cross section method and plotted to 4' contour intervals. A topo survey was also made of the area for the emergency spillway on each structure site. The ends of the valley cross section for the centerline of each dam were marked with iron pins driven into the ground. These pins were tied to reference points, and a sketch of the layout was made in the engineering field books.

A system of valley and stream channel cross sections was taken to conform to the hydraulic and economic needs. All cross sections were tied to elevations above mean sea level carried along the valley of each tributary by a level and compass traverse. The traverse was used also to measure distances between surveyed cross sections. Considerable detail in the field survey of bridges and road fill was made in order to show the restriction to flow.

The dams were designed to conform to Soil Conservation Service criteria set forth in Engineering Memorandum No. 27, Technical Release No. 10, and the National Engineering Handbook.

The sediment storage for all dams is based on accumulation for a 100-year period.

Dams 1 and 2 were planned with 100-year floodwater storage. Dam 3 was planned with 50-year floodwater storage. Water supply for the Town of Chatham was incorporated into the storage of dam 1. Provided there were no other limitations, each site could conceivably store multiple use storage, since the maximum available storage is much greater than the actual storage required for flood prevention only. The water supply in dam 1 is only that required and not the maximum available in the site.

All dams were planned with two stage drop inlets. The orifice openings in the drop inlets were designed in various sizes, depending on the drainage area controlled by each structure. The sizes were adjusted to hold the release rates as low as possible, with due consideration given to channel size and draw down time. Principal spillway conduit sizes were chosen to give release rates that would not cause undue channel excavation and at the same time would not require excessive flood water to be retained behind the dams. The emergency spillway widths were based on a geologic, engineering, and hydrologic study of each site. The main considerations were that the spillway excavation did not exceed the dam fill, allowable spillway velocities, and the possibilities of rock.

Stage-storage curves were drawn from the storage basin topographic maps for use in routing the emergency spillway and freeboard design storms mentioned under Hydraulic and Hydrologic Analyses. These curves were also used in arriving at all water surface elevations behind the dams as well as the height of the dams.

Cost estimates for construction were made for all dams and were based on unit costs of recent jobs completed in Virginia.

From the Chatham Water Pumping Plant to the point at which the Southern Railroad Company relocated Cherrystone Creek, the flood plain is zoned for industrial development. A channel was designed

for a 100-year 6-hour storm through this area. The upper limit of construction for the 100-year channel will be at approximately the upper end of reach II. A dike will be placed across the main stem flood plain along the tributary channel to direct out-of-bank flow into the designed channel. The dike can be constructed by use of material taken from along the tributary channel. This will not only serve to construct the dike but will also increase the size of the tributary channel and thus increase its ability to intercept overbank flow or local inflow. The outlet for the 100-year channel construction had to be accomplished at a gorge area of the flood plain. This area in its present condition would cause back water into the required channel due to its narrowness. Considerable extra excavation had to be put into the channel design to reduce the back water effect and to gradually blend the large channel into a channel designed for a 3-year frequency flow. The spoil from the 100-year channel could be spread when the area is developed, and graded so as to cause better surface drainage.

The flood plain of reaches III and IV is primarily agricultural. The channel design through these reaches was based on a 3-year 6-hour storm. There is a TRANSCO gas pipeline, with three large pipes, intersecting the stream in reach IV. The tops of the pipes are not far beneath the present channel bottom. This presents a problem in getting a well designed channel for the desired level of protection. Lowering the pipes would not be a practical solution to the problem. The pipes, due to their large diameters, do not tend to bend easily and would therefore have to be lowered for a considerable horizontal distance on either side of the creek. The channel was designed in such a way as to pass over the pipeline without disturbing the pipes in their present location.

A set of the Corps of Engineers' "Hydraulic Tables" was used to design the channel. All of the channel design was checked for adequacy by running water surface profiles. The yardage of excavation was computed by the average end area method using the surveyed cross sections. Clearing was calculated by use of recent aerial photographs and field observation. Cost estimates were based on recent channel construction jobs in similar areas.

Tables 3, 3A and 3B were prepared for the work plan to show pertinent data for the dams and the channel works of improvement.

Hydraulic and Hydrologic Analyses

The damage reaches for flood routing purposes were chosen by consultation with the planning party's economist. They were marked on a base map of the watershed that was traced from U.S.G.S. Quadrangle sheets and completed by use of county highway maps. Use of a flood plain map, that was drawn from consecutive contact prints of aerial photographs, was also made in determining the reaches of

the valley for flood routing. The flood plain was roughly outlined on the contact prints by use of a stereoscope during the preliminary study. Corrections, where necessary, were later made in the flood plain width by use of surveyed cross sections of the valley. These cross sections were chosen in such a way as to not only represent the hydraulic characteristics of the valley and channel, but also to represent the width of the valley for the purpose of computing acres of flood plain inundated by various frequencies of storms.

A key storm was developed from historical data and routed through the damage reaches of the watershed. It was used to make adjustments in hydrologic estimations for the watershed. A synthetic storm series was then developed by use of rainfall data obtained from U. S. Weather Bureau Technical Paper No. 40. The storms chosen for routing through the damage reaches were the 2-year, 10-year, and 100-year frequency storms of 6-hour duration.

The drainage area for each subarea of the watershed was planimetered from the U.S.G.S. Quadrangle sheets covering the watershed.

The runoff used in developing the subarea hydrographs for routing purposes was determined from the hydrologic curve numbers for antecedent moisture condition II. The curve numbers were developed from soil cover and land use information provided by the Work Unit Conservationist, Soil Scientist and in conjunction with Virginia Division of Forestry personnel. The procedure used is described in chapters 3.8, 3.9, and 3.10 of Supplement A of the National Engineering Handbook, Section 4.

The hydrographs for each subarea were developed according to chapter 3.21 of Supplement A of the National Engineering Handbook, Section 4, and were routed through the damage reaches of the watershed by the Wilson Graphical Method. Routings were made with the watershed in its present condition. Then the subarea hydrographs were modified for land treatment and were routed with the structures assumed to be in place. After the channel design was made, the routings were again made with the structures in place to determine the effect of the overall project on flood peaks.

Water surface profiles were run through the valley and channel system for the channel in present condition and then with the channel works of improvement assumed to have been completed. The variation of Leach's method, described in chapter 3.14 of Supplement A of the National Engineering Handbook, was used for water surface profiles. Stage-discharge curves were drawn from the water surface profiles for both present condition and with channel improvement completed.

From the flood routings, a discharge-frequency curve was set up for each evaluation reach. This was used along with the stage-discharge curves for each reach to determine the depth of flooding

for various frequency storms. A tabulation of cross section width, valley length, and stage above stream banks was also made. From this a set of stage-area inundated curves was drawn. These curves were used in connection with the stage-discharge curves and discharge-frequency curves to determine the acres of flood plain in each evaluation reach inundated by various frequency storms. This process helped to determine the effect of the floodwater retarding structures and the amount of channel work needed.

A contour map was prepared for the industrial development area in reach II. It is included in the work plan to show the limits of the 100-year 6-hour flood without project and with project installed.

The emergency spillway crest elevations of the dams were set to give the flood storage as determined by use of Technical Release No. 10, prepared by the Soil Conservation Service. A 100-year, long duration rainfall from Technical Paper No. 40 of the U. S. Weather Bureau was used for storage computations on dams 1 and 2. A 50-year, long duration rainfall was used for storage computations in dam 3.

The emergency spillway and freeboard hydrographs were routed through each structure to determine the design high water and the top-of-dam elevations. The hydrographs were developed according to the method set forth in chapter 3.21 of the National Engineering Handbook, Section 4. The rainfall used was based on the Soil Conservation Service class "b" criteria in dams 1 and 2. Greater than minimum "b" criteria was used. Class "a" criteria was used on dam 3. All structure routings were done by the "Upper Darby Method of Reservoir Flood Routing."

Sedimentation Investigations

A field examination of the flood plain was conducted to determine the type and extent of sediment and related damages. Erosion rates were calculated by the use of the Musgrave formula and data from field investigations. Highways were investigated to determine where active bank erosion was occurring.

All procedures and formulas used are similar to those in the Work Plan Party Guide for the Northeast, Chapter IV.

Geologic Investigations

Geologic investigations consisted of a study of the available literature 1/ and aerial photographs of the region and a thorough

1/ Geology and Ground-Water Resources of Pittsylvania and Halifax Counties, Legrand, H. E., VDMS, Bul. 75, 1960.

examination of the conditions in the field. A preliminary examination of each damsite was conducted and depths of overburden were determined where possible with a hand auger and other hand tools.

The structure sites are located in the Piedmont Physiographic Province. The bedrock consists of schists and gneisses. The main minerals present are quartz, muscovite, biotite, feldspar and garnet. Interspersed with the schists are layers of other rocks including hornblende gneiss and granite. The origin of the schist is interpreted as a shaley sediment that has been metamorphosed. The formation is listed as metamorphosed sediments of uncertain age, this formation was formerly called the Wissahickon schist and gneiss whose age is late Pre-Cambrian or Early Paleozoic. All three sites are underlain by quartz-garnet-mica schist with quartz veins interspersed throughout. The depth of rock under the foundations appears to be 10 feet or less. The rock surfaces will be uneven due to the differential weathering characteristics of this rock type. The material to be encountered in the emergency spillways will range from GM to ML with minor amounts of CL being present. Substantial amounts of highly weathered bedrock will be found which will minimize the rock excavation in the damsite. The flood plain alluvium consists of sand and silt with minor amounts of gravel and clay present. Depths to ground water is approximately equivalent to stream level. No geologic conditions were found which would adversely affect construction costs.

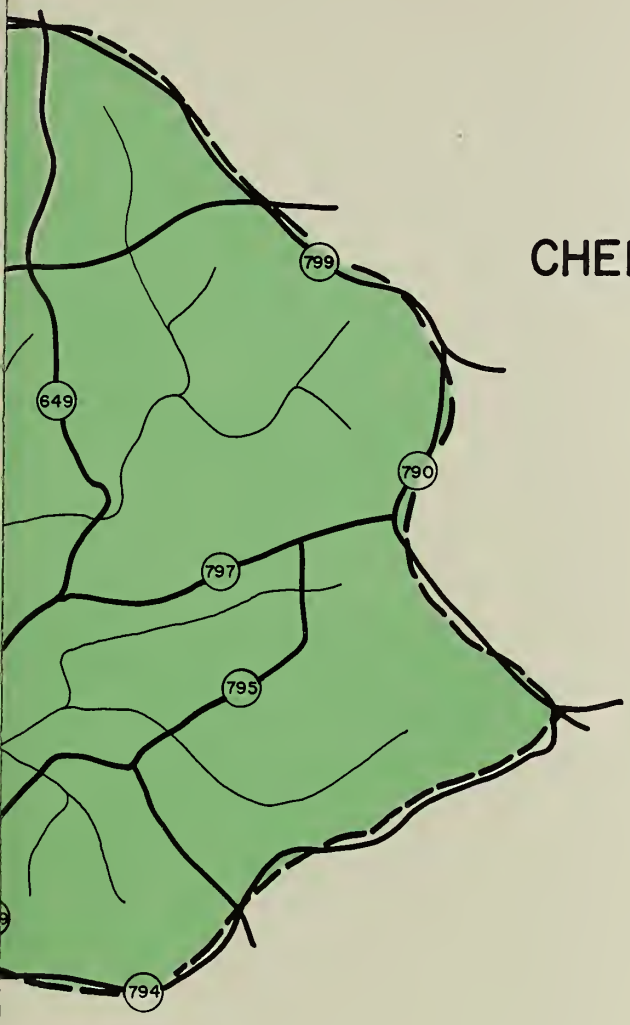
Site #1 - Dam will be 50 feet high and 800 feet long. Abutment slopes vary from 0 to 35 percent. The left abutment is the most suitable for the emergency spillway because a saddle is present which forms a natural spillway. The bedrock is deeply weathered in the right abutment. Seismic velocities indicate weathered bedrock which should almost eliminate any rock excavation. A swamping condition exists on the flood plain at this site.

Site #2 - Dam will be 63 feet high and 400 feet long. Abutment slopes vary from 10 to 60 percent. The spillway will be located through a saddle in the left abutment, weathered bedrock is present but no rock excavation is anticipated.

Site #3 - Dam will be 33 feet high and 440 feet long. Abutment slopes vary from 0 to 30 percent. The spillway will be located in the left abutment, weathered bedrock is present but no rock excavation is expected.

Stream Channel Improvement - A study of the soils and field observation of channel, stream bank and flood plain conditions in the reaches involved indicate rock will have to be excavated in Reach II. Rock estimates were made and included in table 3A. A study of the soils in the channel area indicated the suitability of side slopes.

36°55'



PROJECT MAP
CHERRYSTONE WATERSHED
VIRGINIA

0 1/2 1 1 1/2 2 Miles

79°25'

RE

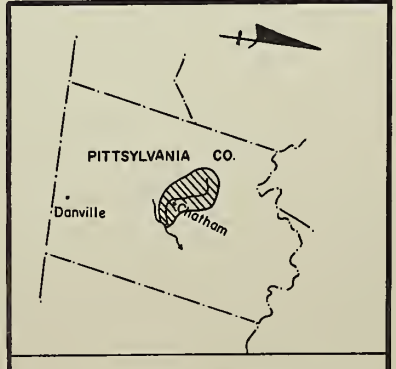
REACH DESIGNATION I II

AREA BENEFITED

PROJECT MEASURES

CHANNEL IMPROVEMENT FOR FLOOD PREVENTION

DIKE



LOCATION MAP

36°55'

USDA-SCS-HYATTSVILLE, MD. 1965

PROJECT MAP
CHERRYSTONE WATERSHED
VIRGINIA

36°50'

36°55'

79°25'

0 1/2 1 1 1/2 2 Miles

DA 3646 Ac.

ROARING FORK

DA 2535 Ac.

GREEN ROCK BRANCH

DA 9410 Ac.

POLE BRIDGE BRANCH CREEK

CHERRYSTONE

1A

Chatham

Southern Railroad

TANYARD BRANCH

Transco

LITTLE CHERRYSTONE CREEK

Pipeline

BANISTER RIVER

57 799 612 821 605 649 802 790 703 823 822 797 795 803 801 802 29 794 685 832 691 694

DRAINAGE AREA CONTROLLED BY STRUCTURE

REACH DESIGNATION I II

AREA BENEFITED

PROJECT MEASURES

FLOODWATER RETARDING STRUCTURE

MULTIPLE PURPOSE STRUCTURE

CHANNEL IMPROVEMENT FOR FLOOD PREVENTION

DIKE

PITTSYLVANIA CO.

Danville

Chatham

LOCATION MAP

USDA-SCS-HYATTSVILLE, MD 1965

Access to Chatham water treatment plant blocked - August 1964

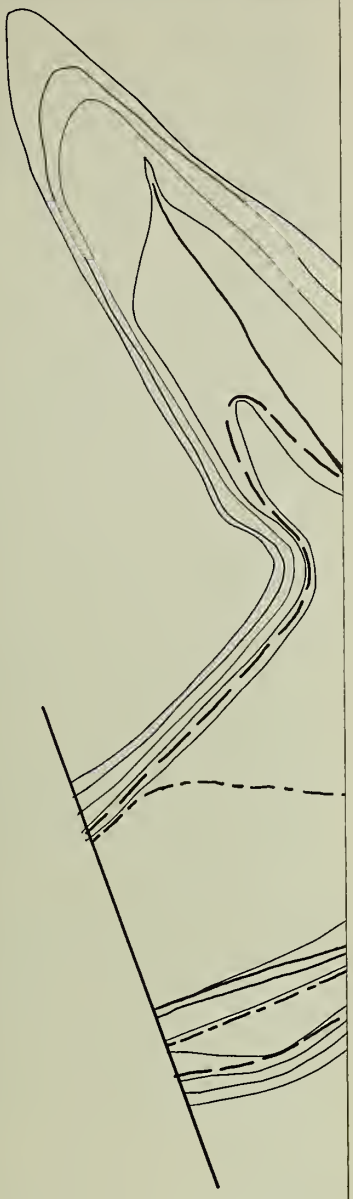
Commercial property flooded in Chatham, August 1964. Equipment caught by quick flooding had to be pulled to safety with tow-truck.

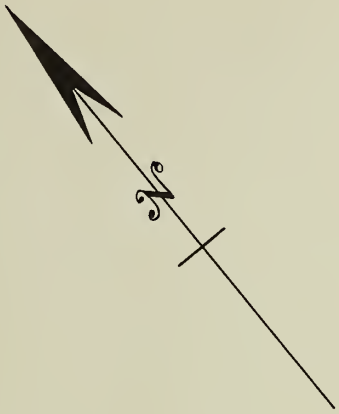
Flooded agricultural land along Cherrystone Creek, August 1964.

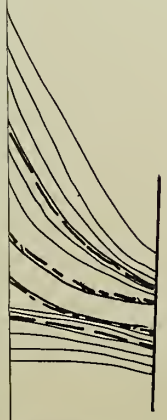
Cherrystone Creek at U. S. Highway 29, August 1964.

August 1964 - Some homes were not severely damaged, but experienced some rather anxious hours.

Valuable floodplain near U. S. 29 flooded to top of fence posts in August 1964.







CHERRYSTONE WATERSHED

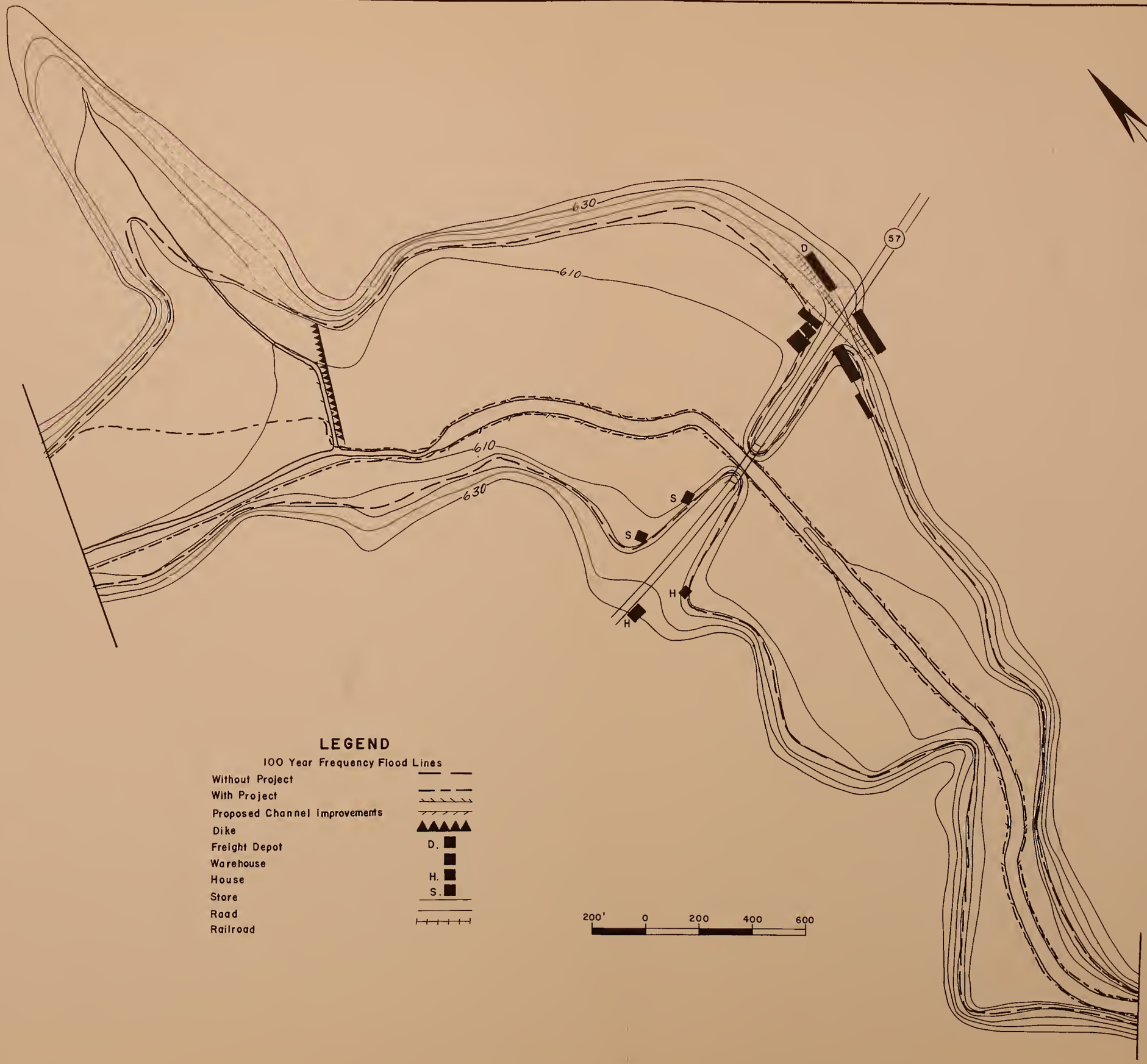
PROPOSED AREA OF ENHANCEMENT

REACH II

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Date	Approved by
Designed	Title
Drawn	Title
Traced E.T.C.	Sheet No. 1 of
Checked	Drawing No. 1

USDA-SCS-HYATTSVILLE, MD. 1965



LEGEND

100 Year Frequency Flood Lines

- Without Project
- With Project
- Proposed Channel Improvements
- Dike
- Freight Depot (D.)
- Warehouse
- House (H.)
- Store (S.)
- Road
- Railroad

200' 0 200 400 600

CHERRYSTONE WATERSHED

PROPOSED AREA OF ENHANCEMENT
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